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AUTHOR Cornett, Lynn M.
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ABSTRACT

This summary examines the shortage of science and mathematics teachers in the Southern Regional Education Board (SREB) states and describes initiatives underway. Fewer persons have been graduating from college prepared to teach and large numbers of science and mathematics teachers are leaving the classroom. At the same time, requirements and enrollments in science and mathematics are increasing. The status in six states is analyzed: Florida, Georgia, Louisiana, Maryland, South Carolina, and Virginia. Trends in teacher preparation figures are also discussed. State initiatives are described including loans and scholarships for teachers in the shortage areas, with specific notes for Alabama, Georgia, Kentucky, Maryland, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia. Alternative certification standards in Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Virginia, and West Virginia are presented. Finally, retraining programs in science and mathematics are discussed, and other state efforts are noted. (MNS)

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Serious Shortages of Science and Mathematics Teachers: What SREB States are Doing

Lynn M. Cornett

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REGIONAL SPOTLIGHT

Southern Regional Education Board

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REGIONAL SPOTLIGHT

SOUTHERN REGIONAL EDUCATION BOARD

NEWS OF EDUCATION IN SREB STATES

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Serious Shortages of Science and Mathematics Teachers: What SREB States Are Doing

Shortages of science and mathematics teachers—they are a reality and will be more severe in the region and the nation in the years ahead. This summary examines the situation and initiatives underway in the SREB states:

Loan Scholarships
Alternative Certification
Retraining Programs

Fewer persons have been graduating from college prepared to teach in the last few years and large numbers of science and mathematics teachers are leaving the classroom. The problem will soon be worse. All SREB states are phasing in increased science and mathematics requirements for high school graduation.

The academic or special diplomas for college-going students that 11 SREB states now or will soon offer usually require three to four years of science and mathematics. One state has already reported enrollment jumps of 22 percent in science and 20 percent in mathematics classes.

SREB states have taken several actions that will influence the supply of teachers. Standards for entrance into teacher education programs, testing for certification, and on-the-job evaluation of beginning teachers are in place in most SREB states. The majority of SREB states either have implemented or are planning career ladder programs to reward performance, and substantial across-the-board pay raises for teachers have accompanied reform efforts.

Additional actions specifically directed toward mathematics and science teacher shortages have been taken. Kentucky was the first state to pass legislation establishing a loan forgiveness program to overcome teacher shortages in these fields. Several states now have alternative certification standards to allow persons who lack education courses but have mathematics and science backgrounds to teach in high schools. Higher education and schools are developing programs to retrain teachers of other subjects for the shortage fields and upgrade knowledge of those on-the-job (many of whom are not now fully certified).

Supply and Demand of Science and Mathematics Teachers

SREB states have surprisingly little hard data on the supply and demand of mathematics and science teachers. Real shortages may be covered up because few states know how many teachers of science and mathematics are teaching without needed subject matter background. A recent national report from the Council of Basic Education notes, "the misassignment of teachers constitutes a scandal in the making for the entire profession."

The report indicates that nationally three-fourths of the states have policies dealing with assignment of teachers out-of-field, but that most states "do not know how much out-of-field teaching goes on." Several SREB states do know. For example, in North Carolina in 1979, 44 percent of the mathematics teachers were teaching out-of-field; by 1984, that had been reduced to 15 percent. This was the result in large part from the state's move to lower a 30-hour major required for certification in grades 7-12 to 18 hours of subject matter preparation for teaching grades 6-9. The state also restricted out-of-field teaching assignments.

Kentucky conducted a study of science and mathematics teachers in the 1984-85 school year and found that most of the occurrences of the out-of-field teachers are in middle/junior high schools. For instance, more than half of the 7th grade biological science classes were taught by out-of-field teachers; this affected more than 17,000 students. In the high schools, the first-year physics classes were by far the largest problem—30 percent were taught by out-of-field teachers. South Carolina found three years ago that nearly one-fourth of its 8th grade algebra teachers were teaching out-of-field; 11 percent of the secondary math teachers were out-of-field.

Florida. Districts in the fall of 1984 reported 26 percent more vacancies than the year before. In mathematics, 589 vacancies were listed in the fall of 1984; a 35 percent increase from the year earlier. In science, 769 vacancies occurred—up 55 percent from the year before. Sixteen percent of the math vacancies went unfilled or were filled out-of-field; that was also true for 22 percent of the science classrooms.

Georgia. A large number of provisional and probationary teaching certificates (issued only at the request of the employing superintendent) were issued during 1985—of 421 in science, 69 were in general science; the state also issued 279 in mathematics. The State Department of Education reports that districts, especially rural ones, indicate need for general science teachers rather than specialists.

Louisiana. Reports are that 25 percent of the general science teachers, 20 percent of physics teachers, 11 percent of the chemistry teachers, 10 percent of the biology teachers, and 75 percent of the earth science teachers in the state were not fully certified for the subject they taught in 1984-85. The state expects an additional 20,000 students to be taking high school science courses next year due to increases in graduation requirements.

Maryland. A recent study by the State Board of Education and State Board of Higher Education is predicting a shortage of over 2,000 teachers in the state between 1987 and 1989. The most critical shortage areas include mathematics, special education, and industrial arts.

South Carolina. A 1986 teacher supply and demand study indicates that through the 1989-90 school year, the number of teachers in the state will remain at approximately the same levels as in 1984-85. Teacher shortages are predicted in mathematics and chemistry, with possible shortages in earth and life sciences, and computer science/data processing.

Virginia. In 1984-85, 40 percent of the earth science courses, 7 percent of chemistry, and 18 percent of the physics courses were taught by persons without science endorsements. Increased enrollments in mathematics and science are expected, due to additional graduation requirements and the enrollment of large numbers of students in the advanced diploma program.

Teacher Education Graduates in the SREB Region

The good news is that math and science teacher education enrollments are apparently increasing; the numbers are not large but they do reverse the decline of recent years. Georgia, for example, had approximately 117 graduates in math education for 1986 (up from 49 in 1982), and a rise in science education graduates from 68 in 1982 to nearly 100 in 1986. The University of Kentucky reports it currently has four times as many mathematics education students as it had four years ago.

By contrast, from 1978 to 1982, science education degrees in the SREB states dropped by 37 percent and mathematics education degrees were down 45 percent. In 1983, 267 math education and 243 science education degrees were awarded in SREB states, up slightly from one year earlier (see Tables 1 and 2). The decline in degrees was more severe for men than women, falling more than 50 percent in both areas; degrees for females fell one-fifth for science education and slightly over one-third for mathematics education (see Figures 1 and 2). These figures do not include non-education mathematics majors who also had sufficient college credits to be certified as a teacher, or those who might be reported as secondary education majors. However, in a recent SREB study, less than 10 percent of those actually eligible for certification were in these categories.

While the "quantity" problems have been the first concern of most states, an SREB study of graduates of 17 universities in the SREB states raises "quality" questions about preparation of high school science teachers.* Science teachers, on the average, earned 49 college credit hours in science, but less than a third of these courses were at the junior or senior level. Science education majors took more biology courses than other science courses. With the diversity of courses taught at the secondary level, especially in rural schools, even fully certified science teachers may not have had even one course in a science subject they are called on to teach. For instance, at one institution, of 15 graduates certified to teach biology, 14 had no physics, and 10 had no earth science courses. Those eligible to be certified as secondary mathematics teaches averaged 33 hours in mathematics, less than half at the upper level. The mathematics education graduates averaged three hours in computer science courses.

**Teacher Preparation: The Anatomy of a College Degree*, SREB, 1985.

Table 1

Science Education Degrees Awarded in SREB States*, 1978-1983

	Bachelor's	Master's	Doctoral
1978	374	246	19
1979	412	203	19
1980	348	208	30
1981	301	160	17
1982	237	152	18
1983	243	219	25

* Does not include Oklahoma

Source: SREB Degree Data, 1978-1983

Table 2

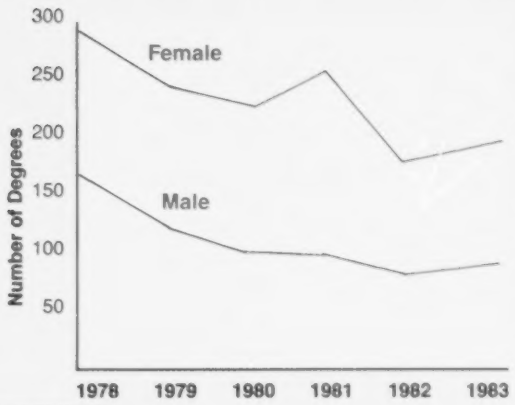
Mathematics Education Degrees Awarded in SREB States*, 1978-1983

	Bachelor's	Master's	Doctoral
1978	445	176	15
1979	348	138	19
1980	316	161	14
1981	333	140	13
1982	247	168	10
1983	267	208	10

* Does not include Oklahoma

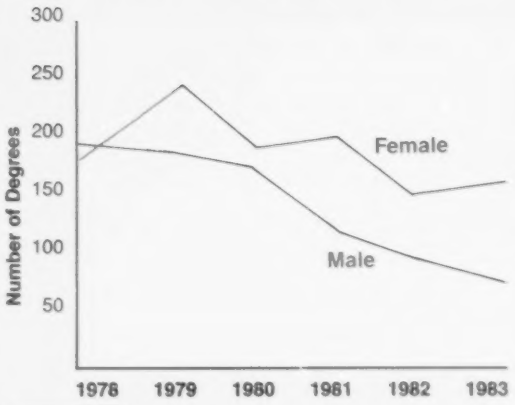
Source: SREB Degree Data, 1978-1983

Figure 1
Bachelor's Degrees in Mathematics Education Awarded in SREB States* for 1978-1983



* Does not include Oklahoma
Source: SREB Degree Data, 1978-1983

Figure 2
Bachelor's Degrees in Science Education Awarded in SREB States*, 1978-1983



* Does not include Oklahoma
Source: SREB Degree Data, 1978-1983

State Initiatives in the SREB Region

There is no doubt that states need to increase the number and qualifications of persons prepared to teach science and mathematics.

Loans and Scholarships for Teachers in the Shortage Areas

Thirteen of the fifteen SREB states have loan or scholarship programs either to attract college students into programs that prepare math or science teachers or for retraining teachers from another field into a field with teacher shortages. In addition, West Virginia and Louisiana have scholarship programs for talented education majors. (Louisiana's program has recently been funded.) Alabama, Florida, South Carolina, and Texas are appropriating more than $1 million per year for this purpose; Arkansas, Georgia, Maryland, and Mississippi provide funding under $200,000; other states are somewhere in between. Initially several states had fewer applicants than expected, but now substantial numbers of qualified undergraduate students and teachers are applying for the programs.

Most programs require one year payback for each year of the loan. However, Texas requires one year for each semester; Alabama requires three years for each loan year; Oklahoma forgives the entire loan in three years; and Arkansas and South Carolina forgive 20 percent of the loan for each year of teaching. Maryland and Florida reduce the payback for specially designated schools. In Maryland the one-and one-half year obligation is reduced to one year for teaching in certain geographic areas; Florida's two-year payback per loan year is reduced to one year for teaching in rural and disadvantaged schools.

Alabama. The loan scholarship program was started in 1983-84 with $50,000. That amount increased to $600,000 in 1985, and for fiscal year 1986, it was $1.2 million. Initial response to the program was slow; however, now that information about it is widely known, the response has been good. In 1985, 198 students received loans under the program (which awards up to $4,000 for each of two years of undergraduate training in shortage areas); 66 percent of the loans went to mathematics education majors, 13 percent in general science, and 10 percent in biology. The other loans were in specialty areas of the physical sciences.

Georgia. During the first year of Georgia's Direct Student Loans for Teacher Training in Math, Science, and Special Education, only $100,000 of the available $135,000 was used for the program. A cap on parental income decreased the number of applicants, and the required grade point average (G.P.A.) of 3.0 eliminated a number of persons who applied. The regulations were revised after the first year—the G.P.A. requirement was lowered to 2.75 (to align with state teacher education requirements) and the income cap was raised. A greater number of scholarships have been awarded to teachers desiring retraining rather than those pursuing a first degree. In 1985 almost twice as many loans were given in special education as in science and mathematics combined.

Kentucky. Started in 1982, the Kentucky program awards loan scholarships to undergraduates in shortage areas as well as providing funding for summer retraining programs for teachers to become certified in science and mathematics. The 1985-86 appropriation was over $430,000, with 174 scholarships awarded for $380,000; the remaining amount has been used for the summer retraining program. Of the almost 400 active scholarships, 85 percent of the recipients are either continuing to pursue a degree in science or mathematics education or are currently employed in the public schools of Kentucky. The other 15 percent includes those who have changed majors or dropped out of school, are not teaching to fulfill their obligation, or are teaching in a private school or a school outside the state.

Maryland. A state scholarship fund designed to provide grants of up to $4,800 per year in shortage areas (which include mathematics and science) has attracted four times as many applicants as money was available. In 1985-86 the programs provided 60 students with $142,000. Additional money has been requested for next year.

North Carolina. The North Carolina Prospective Teachers Scholarship Loan Program provided $800,000 (in loans of $2,000 per year) in 1985. Students entering mathematics and science teacher education receive preference for the scholarships. The fund was increased to $1.2 million for 1986 and will go up to $1.6 million in 1987.

Oklahoma. The 1985 legislature established the Future Teachers Scholarship Program, which provides scholarships to outstanding high school graduates or college students with an interest in teaching in shortage fields (including science and mathematics) in the state. Preference is given to students who rank in the top 15 percent of their high school class or score at or above the 85th percentile on the ACT or other batteries of tests. Graduates or transfers from two-year institutions are also eligible for the programs. Funds are allocated to institutions, which make the decisions on applicants. Students with less than 90 hours of college credit are eligible for $1,000 per year awards; those with more than 90 hours, for $1,500 awards. Recipients agree to teach in a shortage area in public schools in the state for three years upon graduation. In 1984-85, 94 scholarships totaling $89,500 were awarded. The State Regents for Higher Education has recently established procedures for a forgivable loan program for students enrolled in programs preparing them to be teachers in mathematics, science, foreign language, or computer learning. The appropriation for fiscal year 1986 was $200,000.

South Carolina. 1984 legislation authorized the Teacher Loan Program. State residents may receive loans to attend college to become certified teachers in critical shortage areas. The areas of need include rural areas and particular subjects, to be identified yearly. The loan is cancelled at the rate of 20 percent for each year of teaching in the state's schools. In 1984, 327 persons received loans valued at $785,000. The volume of loans is expected to increase for 1986-87, with $2.5 million available for the program.

Tennessee. Over 125 loan scholarships were awarded to undergraduate students and current teachers seeking certification in shortage areas during 1984-85. In 1985-86, the awards, totaling over $200,000, went to over 170 applicants. Two-thirds of the loans went to college students; the remaining to teachers for retraining. The requirements for undergraduates included a G.P.A. of 3.0 and an ACT score of at least 19, with an ACT of 21 desired.

Virginia. 137 scholarship loan awards totaling $274,000 were made to college juniors and seniors for the 1985-86 year. Mathematics majors account for 60 percent of the awards; the remainder were in science. Of the 54 science awards 33 were in earth science, chemistry, and physics. In 1984-85, 59 scholarship loans worth $115,000 were awarded.

Alternative Certification Standards

A majority of the SREB states have legislative or state board mandates that call for development of alternative routes of certification for teachers. (These programs have specific requirements—and are not intended as emergency certification. They generally require fewer numbers of education courses for certification or an alternative method, other than college coursework, for meeting specific competencies.) (See Figure 3.) The programs are generally for secondary teachers and require a bachelor's degree in the subject area to be taught. Many are designed to encourage persons from other fields to become teachers. About half of the state programs are aimed specifically at shortage areas such as mathematics and science. Because most of these programs are relatively new, it is too early to know whether substantial numbers of teachers will enter the profession through them. Virginia's plan has been in existence for several years, and approximately 10 percent of the secondary teachers certified each year gain certification through the alternative program.

Alabama. 1984 legislation allows for provisionally certified persons to be employed in "critical need" areas when no regularly certified person is available. Candidates must possess a bachelor's degree in the subject area to be taught.

Florida. A 1984 alternative certification law, recently implemented, includes a modified beginning teacher program to attract liberal arts graduates into teaching without completion of the required education courses. Pinellas County school district has approved an alternative certification program for middle school and high school teaching. Participants must hold a bachelor's degree in the subject to be taught and complete a year's internship, which includes an intensive three-week training session.

Georgia. The 1985 Quality Basic Education Act provides for granting renewable certificates to persons who have not completed a teacher education program. A bachelor's degree in subject area, one course in human growth and development, and a one-year internship, as well as passing teacher certification tests, are required.

Kentucky. Legislation passed in 1985 called for the State Board of Education to establish regulations for persons with training and experience in shortage areas to be employed when a certified teacher is not available.

Louisiana. A person who holds a bachelor's degree in a subject area and has a passing score on the National Teachers' Examination may be provisionally certified and enter an intern program developed through a college or university. For

Figure 3
Alternative Certification for Teachers

	Bachelor's Degree in Subject Area	Certification Test	Internship	Additional Training	Teachers Eligible
Alabama	X	State-approved district plan			Critical need
Florida	X	Pass	X	X	Secondary
Georgia	X	Pass	X	X	Critical need
Kentucky	X	State-approved district plan			Critical need
Louisiana	X	Pass		Program developed w/college	Secondary
Mississippi	X	50th percentile on NTE	X	X	Secondary
North Carolina	X	Pass		Program developed w/college	Critical need
Oklahoma	X	Pass	X	X	Not restricted
South Carolina	X	Pass		Program developed w/college	Critical need
Texas	X	Pass	X	X	Critical need
Virginia	X	Pass	X	Coursework or demonstration of competency	Secondary
West Virginia	X	Pass	X	Demonstration of competency	Critical need

instance, at Louisiana State University the Accelerated Post-Baccalaureate Certification Program, which provides students with $1,000 scholarships, substitutes full-time teaching for student teaching and offers courses for completion of certification requirements.

Mississippi. Beginning in 1986, a bachelor's degree, a 51st percentile or higher score on the NTE, 12 hours of education courses (educational psychology methods, etc.), and on-the-job assessment during the first year will qualify persons for certification through an alternative program.

North Carolina. The Lateral Entry Program was established by the 1985 legislature. Applications are to be submitted by an individual and the employing school system. Initial certification procedures are to be completed and previous experience is to be evaluated by an institution of higher education in relation to competencies needed for certification.

The Science and Mathematics Education Center at East Carolina University is offering a new program this year. Participants must have completed academic preparation in science or mathematics with a 2.2 G.P.A. and have met the minimum scores North Carolina requires on the National Teachers' Examinations Core Battery I and II. In the summer of 1986, participants took a six-week session in math or science on campus (the program can accommodate up to 20 students) covering such topics as instructional planning, managing the classroom, and nature of the learner. During the 1986-87 school year, individuals will teach part-time in area high schools under the supervision of a mentor teacher, will attend weekly seminars, and their work during the year will be supervised by university faculty. The programs will conclude with a one-week seminar in the summer of 1987. Completion of requirements for a master's degree can be attained with additional work during a five-week summer period. School districts will provide participants with a stipend for the year to cover living expenses. The summer programs are paid for by funding available through the Science and Mathematics Education Center.

Oklahoma. The State Board of Education established guidelines for an Alternative Certification Plan in 1986. Upon request of a district a person may receive temporary certification under the plan, which specifies guidelines that include supervised teaching, meeting admission standards to a teacher education program, and completion of professional education courses. Although not allowing an alternative means of meeting professional education requirements, the program provides more stringent guidelines than the usual emergency certification.

South Carolina. The Education Improvement Act of 1984 called for the establishment of a program for persons with a bachelor's degree and subject matter expertise to become certified. The program includes a summer session, meetings during the year, and completion of three graduate courses.

Winthrop College School of Education is the site for the state-funded alternative certification pilot program for science and mathematics teachers. Last year the Alternative Certification Institute enrolled 83 students in the program, which began in 1985. About one-half were women. One-half of the students teach science; the other half, mathematics. Candidates must possess a bachelor's degree in the subject area, have been hired for a position in a school district, and have passed the NTE subject area test. The candidates are given provisional certification, with three years to become fully certified. The program includes an intensive one-week session in planning, teaching methods, and classroom organization, and monthly seminars during the year. Faculty members also conduct site visits during the year. Participants complete an intensive four-week seminar in the summer that includes a concentrated course in effective teaching and one on teaching in the secondary subject—mathematics or science. These courses carry six hours undergraduate credit. (The seminars and one-week course provide three hours of graduate credit.) To become fully certified, participants must complete an additional three courses (in reading, human growth and development, and exceptional children) within a three-year period. The program has drawn larger numbers of persons than originally expected and will be expanded this year. Winthrop hopes to involve to a greater degree teachers at the district level working with provisional teachers during the internship year.

Texas. 1984 legislation permits alternative certification of college graduates who have not completed a teacher education program. The candidates must pass the state competency test, serve a one-year supervised internship, and complete classroom management training. A 1985-86 program in the Houston Independent School District trained 250 interns; over 6,000 inquiries about the program were made. Candidates completed a 124-hour training program, were assessed on performance every six weeks, and passed competency tests before recommendation for full certification.

Seven programs, involving 29 school districts, were approved for the 1986-87 school year. Ten higher education institutions are participating in the programs. Sponsors of the programs include school districts, a region service center, and universities across the state. All plans include training before taking on classroom responsibilities (such as planning and teaching lessons and classroom management; an internship with release time for the intern to be observed by master teachers; and coursework to be delivered by a higher education institution or by district staff). All interns are evaluated on performance in the classroom. Program evaluations will include comparisons of persons completing the programs with first-year teachers who have completed traditional programs. Some districts will also compile student outcome data in evaluating the alternative certification program.

Virginia. Since 1982, arts and sciences graduates have been granted provisional certification for secondary school teaching. Requirements include passing the certification test, employment, and a bachelor's degree in the subject area to be taught. During the two years of provisional status, teachers are assessed on the job (as are all new teachers) and must either complete nine hours of coursework or demonstrate competencies (including organization of instruction, and evaluation of student performance and classroom performance) through a district-designed program.

Several institutions in Virginia, including Virginia Wesleyan College and George Mason University, are offering programs to enable persons to move from other career fields into teaching. At Virginia Wesleyan, persons with a bachelor's degree in mathematics, science, foreign language, or English can take an abbreviated teacher education program. The program is designed to provide professional knowledge for persons with degrees in the arts and sciences. The plan includes three education courses (including field experiences) and student teaching for eight to nine weeks.

George Mason has an alternative program for persons interested in changing careers and becoming physics, chemistry, or earth science teachers. The program consists of a one-semester program in which students earn 15 hours of graduate credit. The program includes three courses (with field experiences) as well as an eight-week practicum. All courses are held in the public schools in Arlington; clinical experiences are in the Fairfax County and Alexandria schools. The State Department of Public Instruction has encouraged such programs and development of an alternative program is underway at Virginia Commonwealth University.

West Virginia. The State Board of Education has approved a public school-higher education partnership to provide professional training for individuals in selected shortage areas who do not hold teaching certificates. The program is designed to prepare fully licensed teachers through a summer session and year-long internship. The program is jointly administered by the West Virginia College of Graduate Studies, the West Virginia Institute of Technology, and West Virginia State University, with internship sites and mentor teachers provided in the Kanawha and Boone County public schools. The project is jointly funded by the Department of Education and business and industry. Programs for each individual will be developed after an assessment of competencies by a support team comprised of the mentor teacher, a principal, and a higher education faculty member. During the summer of

1986, participants received instruction in human development, principles of instructional design, learning and teaching strategies, and classroom management.

Certification standards for mathematics and science teachers have recently been revised in several SREB states. Tennessee has outlined specific math courses (total of 36 quarter hours) for certification of secondary mathematics teachers—courses with less than a prerequisite of two years of high school algebra are not counted for certification. In 1984, Tennessee raised the science requirements for elementary teachers from 12 to 18 quarter hours, with both physical and biological sciences required. Kentucky upgraded the requirements for middle school science teachers to include 9 hours of biology and 9 hours of earth science, chemistry, or physics, plus 6 hours in the remaining sciences. Changes were also made in standards for elementary and high school teachers. Recent revisions of certification standards in Oklahoma include raising the number of hours required in secondary school specialization—in science to 36 semester hours, and in mathematics to 28 semester hours.

Retraining Programs in Science and Mathematics

State funding of programs includes Florida's $9 million for summer institutes in each of two years (1984 and 1985) to increase subject area competencies of science and mathematics teachers. Over 11,000 teachers were trained during the summer of 1985. In-service education of science and mathematics teachers was the focus of Florida's $2 million Postsecondary Education Program of Excellence for cooperative projects among colleges, businesses, and schools. South Carolina began a $1 million program in 1983 for retraining teachers of other disciplines for science and mathematics.

Virginia's state-funded program that awards grants to colleges for institutes to increase the supply of fully certified teachers has developed from pilot programs in 1983 to grants of over $600,000 awarded to 15 projects for 1985-86. More proposals were submitted than could be funded. Over 500 teachers have participated in the classes over a three-year period. Several of the institutes are cooperative efforts of colleges and schools. The institutes are for teachers who want to add a science or mathematics endorsement to certification, or retraining experienced, in-field teachers in mathematics, chemistry, earth and space science, and physics. (These are the areas with the greatest number of unendorsed teachers in the state's classroom.) Institutions receive $90 per teacher per semester hour.

North Carolina provided over $1 million in 1983 for summer institutes for the retraining of middle school mathematics and science teachers at institutions throughout the state. The six-week institutes, which emphasized subject matter, were attended by 500 teachers. Teachers were paid stipends of $35 per day and did not pay tuition for courses. Similar institutes were held during the summers of 1984, 1985, and 1986. The General Assembly in 1984 also funded a Math-Science Education Center Network, with headquarters at the University of North Carolina, Chapel Hill. The eight centers in the network focus on increasing the quality and availability of science and mathematics teachers. Centers provide in-service education and conduct research activities in cooperation with public schools.

Alabama's 1984 Education Reform Act established in-service training centers at colleges and universities in the state; $2 million was available for summer institutes in 1985.

A state program funded in Maryland in 1984 that provides tuition reimbursement for teachers training in mathematics and science has attracted only small numbers. Reimbursement is made after teachers complete certification requirements.

In Anne Arundel County, Maryland, the shortage of teachers in mathematics and science became a serious problem. A program developed by the district provided for K-9 and secondary certification upgrade. Local colleges and universities were invited to submit proposals to become partners and provide courses at county schools; the University of Maryland was selected. Courses that did not qualify for graduate-level content work, but which could be counted for certification, were given special designation. At the elementary level, teachers needed subject matter expertise. At the secondary level, teachers certified in biology and general science (where no shortages existed) took courses to become competent in chemistry and physics. (Secondary teachers also took courses for competency in teaching advanced placement courses in chemistry and physics.) The secondary program offers four courses in chemistry, four in physics, and two optional courses. The district pays tuition for those who maintain a "B" average and agree to work an additional year in the system. The district estimates the cost of producing a certified physics teacher is about $2,000.

A program of the University System of Georgia is designed to assist middle school and secondary mathematics and science teachers in modernizing curriculum and updating content knowledge. The Board of Regents approved 39 of 45 proposals submitted for funding during 1985-86. Projects were collaborative efforts with schools, and involvement of arts and sciences faculty was strongly urged. Funds were based on tuition costs for teachers plus up to 20 percent additional expenditures available for the projects. Programs included "Improving the Teaching and Learning of Chemistry," at Berry College; "Workshops for Integrating Computing into Science Teaching and Learning," at the University of Georgia; and "Introductory Statistics and Probability for Secondary School Mathematics and Science Teachers," at Georgia Southern College.

The Board of Regents in Oklahoma coordinated three institutes last summer to train teachers in shortage areas such as science, mathematics, and foreign languages. The institutes were aimed at additional training for teachers to move into high need areas or additional training for those on-the-job. Persons who did not hold degrees in education and wanted to become certified could take a concentrated

group of education courses.

Institutions are responding with programs. Texas A&M University has established a Center for Mathematics and Science Education to help meet the shortage of mathematics and science teachers in that state. In a joint program of DeKalb County Schools and Georgia State University, a two-year graduate program in mathematics was recently completed by 18 teachers in the school system. The courses were held at the district offices and tuition was paid by the school district. Teachers are committed to teaching one quarter for every course funded by the district. The program is reported to have been endorsed enthusiastically by participants.

Federal funding available for upgrading science and mathematics instruction produced an effort of five school districts in eastern North Carolina and East Carolina University. Because recent changes in state curricula now call for two years of integrated science in 7th and 8th grades, as opposed to life and earth sciences courses, middle school teachers need a broader base to teach these courses; that is the focus of the project this year.

Through matching a $90,000 federal grant, Tulane University in Louisiana is providing free tuition in a year-long program for retraining teachers to become certified in mathematics, earth science, or computer science.

The University of Georgia College of Education has a project with Clarke County Schools offering incentives for mathematics and science teachers. Called the Georgia Teacher Fellow Program in Science and Mathematics, teachers named as fellows assume professional responsibilities that include serving as model teachers.

Other State Efforts

In addition to retraining efforts, states are using a variety of other approaches to meet teacher shortages. Florida, Maryland, North Carolina, Oklahoma, and South Carolina have established statewide teacher recruitment agencies to deliver information about vacancies and to recruit for the teaching profession. In Texas and Virginia, advanced mathematics courses are being offered through interactive television networks; the program has been useful for rural districts. (Oklahoma has used this method to teach German.) An instructional telecommunications network has been established in eastern North Carolina through the Rural Education Institute at East Carolina University. During 1985-86, a course in principles of technology combined academic physical science and vocational education.

Partnerships with business and industry have produced programs to retrain teachers and provide needed equipment. In North Carolina, an alliance with business has produced several programs, one of which gives business awards to outstanding teachers of science and mathematics. In North Carolina, funding extended the employment of 700 math and science teachers in the summer of 1985 to retrain teachers in the profession and to improve science and mathematics education. Legislation in North Carolina also provided additional funding to districts on a per pupil basis for science and mathematics equipment and materials for "hands-on" instruction.

The SREB states have taken steps to meet the growing shortage of mathematics and science teachers in the region. Monitoring the effectiveness of the programs should be undertaken by universities, state higher education agencies, and state departments of education.

This edition of *Regional Spotlight* was prepared by Lynn M. Cornett, Associate Director for School/College Programs, SREB.

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